

NSF Committee of Visitors for IOS/ BIO

Response to the COV Report

July, 2008

Summary

IOS Comments: IOS appreciates the COV's positive comments regarding the IOS merit review process, selection of reviewers, balance in the awards portfolio, program management, and their laudatory comments regarding current investments. IOS also appreciates the COV's support of the transition from IOB to IOS and their acknowledgment of the positive results derived from the realignment, especially the recognition that IOS is now appropriately positioned to strengthen linkages across BIO and other NSF Directorates. COV recommendations are addressed below (**IOS comments**).

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

A.1 Quality and Effectiveness of the Program's Use of the Merit Review Process

1. Review Methods

PI proposals are reviewed by a combination of ad hoc reviewers and panelists in a very thorough and fair manner. Because there is no triage, every proposal submitted is given a complete review. The activities of the panels are well documented. By contrast, the internal review process (subsequent to the panel) that leads to the final funding decision is less transparent, but conversations with the Program Officers suggested a fair and effective process. Proposals submitted by current panel members are reviewed by ad hoc reviewers and Program Officers. The COV did not review the results of submissions by current panel members, but this circumstance is rare. The only example that occurred during the time frame that the COV reviewed was handled well.

2. Review Criteria Addressed

The Intellectual Merit criterion is typically very carefully addressed by individual reviewers, although the quality of individual reviews is variable. Individual COV members reviewed ad hoc reviews from 78 proposals. On the basis of this informal survey, the COV concluded that the Broader Impact criterion is typically not as well addressed as the Intellectual Merit criterion, particularly in ad hoc reviews. Discussions with Program Officers, however, indicated that they provide appropriate instructions to reviewers.

A review of a sample of panel summaries by individual COV members indicated that panel summaries typically include a statement on the Broader Impact criterion. These statements varied in their depth and detail. In some cases, the proposed Broader Impact activities were simply described without evaluation. The COV feels that this is unacceptable. A trend was noted that the more recent panel summaries (from 2007) were more balanced in their

use of both criteria. This presumably reflects the instructions given by the Program Officers, the use of a panel summary template, and review by the Science Assistants. However, the quality of the panel summaries is still not uniformly excellent, suggesting that the process by which the panel summaries are produced requires additional refinement.

A review of a sample of Program Officer review analyses by individual COV members indicated that the review analyses are typically more thorough than the panel summaries in that both criteria are carefully addressed in depth. The review analyses could be used as a model for the panel summaries.

IOS Comments: IOS Program Directors continue to stress the importance of the Broader Impact Merit Review Criterion to ensure thoughtful and thorough consideration during panel discussions. This is accomplished by extensive discussions during the panel orientation process, outreach visits, and individual conversations with PIs, panelists, and ad hoc reviewers. As the reviewing community better understands NSF's goals for requiring articulation of the Broader Impacts, the reviews are becoming more balanced in evaluating both merit review criteria, as was clearly noticed by the COV. In addition, the BIO Directorate now includes a link to representative broader impact activities.

3. Substantive Reviewers' Comments

The COV felt that the majority of reviewers provide substantive and useful comments that explain their assessment of the proposals. Our conclusion is based on review of the eJackets provided by IOS and the considerable experience of COV members on panels.

4. Panel Summaries

The COV examined more than 80 eJackets to determine the quality and thoroughness of the panel summaries. The COV finds that the vast majority of panel reviews stated clearly the rationale for the priority ratings. At the current funding rate (only 59% of proposals receiving the highest ranking by the panel), it is difficult to determine the criteria that are used to distinguish among the most meritorious proposals.

IOS Comments: IOS Program Directors consider a variety of factors in developing their award recommendations, including the need to create a diverse scientific portfolio as well as considerations with respect to institutional, geographic, and PI diversity. Managing this is a topic of discussion at the post-panel debriefings, at the annual Division Retreat, and throughout all orientation activities for new Program Directors.

5. Review Analyses (rationale for award/ decline decision)

The review analyses written by the Program Officers clearly describe the rationale for the award/decline decision.

6. Documentation to PI (rationale for the award/decline)

The COV felt that the answer to this question is generally yes, but that the quality of the panel summaries often did not match the quality of the review analyses prepared by the Program Officers. Because the panel summary is a critical part of the documentation provided to the PI, PIs (and future panels reviewing resubmissions) are poorly served by a cursory panel summary.

IOS Comments: IOS senior managers have begun providing specific instructions during the panel orientation period so that panelists better understand the function and importance of the panel summary. IOS panels have adopted a new practice of, in addition to the primary and secondary panel review, utilizing a third panelist who reads the proposal and then remains attentive and take notes during the panel discussion. This practice allows for a more comprehensive panel summary that includes all aspects of the panel discussion. IOS staff read the panel summaries as they are being prepared and provide immediate feedback to the panelists as necessary in an effort to continue to improve the quality of these important documents.

7. Time to Decision

Time to decision was well-documented in the self study.

8. Quality and Effectiveness of program's use of merit review

The COV was unanimous in its opinion that panels are dynamic and are doing an exceptional job. The IOS should consider the possible benefits of holding some panel meetings on the west coast, similar to recent procedural changes at NIH.

IOS Comments: Although the NSF is well-invested in ensuring that the reviewing community is geographically diverse, budgetary constraints at the present time do not allow for panels to take place on the west coast.

A.2 Selection of Reviewers

1. Appropriate Expertise of Reviewers

Based on our review of the packets and extensive COV member panel experience, the COV felt that reviewers are top tier and geographically well distributed. The COV thought that the use of international reviewers was appropriate and beneficial.

2. Reviewers' Balanced Characteristics (geographic, type of institution, underrepresented groups)

The COV noted that significant attention is paid to racial, ethnic, and gender diversity in recruiting reviewers. However, the COV found it surprisingly difficult to obtain appropriate descriptive data on reviewers. COV is concerned that in this time of low funding, Program Officers have found that it is more difficult to recruit reviewers and panelists.

IOS Comments: IOS Program Directors strive to insure diversity in the selection of ad hoc reviewers, panelists, and Program Directors. The importance of broadening participation, and mechanisms for achieving these goals, are part of

the IOS module on “how to recruit minorities” that is part of our orientation activities for new Program Directors. The Directorate continues to maintain a database of prospective reviewers, panelists, and Program Directors who are members of underrepresented groups. The Foundation has now followed suit and is actively incorporating features that identify such groups within its new comprehensive reviewers’ database that is expected to be released within the next few months.

3. Recognizing and Resolving Reviewers’ COI

Yes-no additional comments.

A.3 Portfolio of Awards under Review

1. Quality of Research and/or Education Projects Supported

Based on reviews of jackets and highlights, the COV concluded that the IOS portfolio is of extremely high quality. However, many of the descriptive data that support this conclusion are buried in annual and final reports, and therefore are not easily accessible.

IOS Comments: IOS concurs with the COV that the template for Annual and Final Reports creates considerable challenges for the NSF staff in extracting meaningful quantitative and qualitative information on the outcomes from NSF awards. Because this is an NSF-wide template, IOS will convey these concerns and subsequent recommendations to the working group now developing the new templates.

2. Promotion of Integration of Research and Education

In this directorate (in particular), broader impacts generally address the integration of research and education. In our sample of approximately 80 randomly selected proposals, the vast majority included integration of research with education as a central component of the Broader Impact activities. Further, the total number of graduate students supported on research grants in IOS over the time period considered was 1783, approximately 2-2.5 students/award. Given the importance of broadening participation in science at all levels, the COV would have liked to have been able to describe the demographics of the graduate and student populations supported (including ethnicity, gender, state or country of origin, institution type).

IOS Comments: While IOS shares the COV’s desire for quantitative information related to demographics of the various populations supported, we are limited by law to information only from those individuals who elect to self-identify as being of a certain ethnicity or gender.

3. Appropriate Award Size and Duration for the Scope of the Projects

Clearly, budgets are narrowing the scope of proposals. Low budgets are limiting the potential for innovative and transformative research. Further, because of declining funding rate, MANY meritorious awards are not being supported.

IOS Comments: IOS shares the obvious concern of the COV that budgetary constraints result in a decreasing ability to recommend funding for many meritorious proposals.

4. Balance of Innovative / Potentially Transformative Projects

IOS is consistently supporting exciting and innovative projects, some of which are potentially transformative. It is clear that IOS is working to educate the scientific community to identify the transformative aspects of their work. The COV did not equate SGER awards with transformative work, and that view was shared by the Program Officers. In discussions with the Program Officers the number of proposals that were identified as transformative was on the order of 5-10%. Further, they clearly considered transformative potential in their prioritization of proposals for funding. This criterion was complementary to evaluation based on the Intellectual Merit and Broader Impacts of the proposal. In future, proposals with transformative potential will be easier to identify if this designation is formally tracked in the project jackets (for example, this information could be included in the Program Officer's review analysis).

IOS Comments: During the panel orientation panelists are given written descriptions and specific instructions in identifying potentially transformative proposals. The Foundation has charged a Cross-Directorate Working Group to develop recommendations for identification and tracking of potentially transformative proposals.

5. Balance of Inter- and Multi-disciplinary Projects

The systems emphasis of IOS allows the vast majority of awards to serve as links across biology, from molecular to environmental biology. IOS has been particularly active in promoting inter- and multi-disciplinary projects. The COV learned that co-review across clusters, across divisions, and even across directorates was not uncommon, but detailed numbers were not available. However, 21% of IOS proposals are co-funded, usually between divisions and/or directorates. Other measures of inter- and multi-disciplinary are difficult to extract. It would be useful, for example, for Program Officers to include in the review analysis a statement that the proposal is either inter- and/or multi-disciplinary in nature.

IOS Comments: IOS currently requires its Program Directors to formulate a review analysis that addresses the co-review process. Further instructions will be given to better articulate in the review analysis the inter-, multi- and transdisciplinary nature of the proposed research. The Foundation has charged a Cross-Directorate Working Group to develop recommendations for identification and tracking of interdisciplinary projects.

6. Portfolio Balance (award size, single/ multiple investigators/ other characteristics)

The COV has no concerns about IOS activities in this area (portfolio balance). In addition to the interdisciplinary nature of the division, approximately 33% of awards granted are multi-disciplinary. However, the COV wonders if IOS budget constraints limit the feasibility of multi-investigator projects.

IOS Comments: IOS is committed to making awards that result in a balanced portfolio. This includes, when possible, multi-investigator projects. NSF has numerous cross-Foundational programs that target multi-investigator projects requiring larger budgets. Program Directors work across the BIO Directorate and Foundation in an effort to co-fund projects as appropriate. In addition, a pool of funds is held in reserve by the IOS Division Director each year to provide incentives for a variety of activities, including investments in multi-investigator projects.

7. Portfolio Balance in Awards to New Investigators

The data in the self-study suggest that new investigators are funded at a rate slightly lower (12%) than all investigators (16%). The COV would like to see increased success among new investigators. IOS should develop and then better advertise mechanisms to improve the quality of submissions by new investigators. For example, the IOS could better utilize FastLane and the IOS homepage to direct new investigators to available proposal preparation resources.

IOS Comments: IOS appreciates this suggestion and thinks that this should be extended to the entire Directorate. We will work with the other Divisions in BIO to identify and/or develop appropriate resources and make them available via the BIO homepage.

8. Portfolio Balance in Geographical Distribution

IOS awards continue to be concentrated in historically research-intensive states. The COV recommends continued outreach to PIs from EPSCoR states.

IOS Comments: IOS remains committed to outreach activities to EPSCoR states and will continue to emphasize the importance of this as IOS staff travel plans are developed each fiscal year.

9. Portfolio Balance in Institutional Types

The higher success rates of applicants from 4-yr colleges demonstrate the efficacy of the use of RUI and RIG programs by IOS. Funding success rates of doctorate vs. non-doctorate institutions are very similar, which the COV commends. The COV encourages IOS to promote applications from Tribal colleges and universities; the COV remarked that there were no such applications in the last three years.

IOS Comments: The IOS commitment to broadening participation, including involvement with Tribal colleges and universities, can be evidenced by the number of outreach visits conducted by IOS Program Directors. IOS will continue and intends to increase its number of outreach visits in hopes that proposal submission rates will improve for tribal groups. The BIO sponsored Research Initiation (RIG) and Career Advancement Award (CAA) programs are ideal for stimulating proposals submission by tribal groups who are interested in RIG/ CAA funding. In addition, the IOS Acting Division Director participated in the Tribal College Leadership Conference and in the review of oral presentations by Tribal College Students at the EHR Joint Annual meeting this year. The IOS Acting

Division Director will participate in a one-day grantsmanship workshop for Tribal College faculty in November, 2008.

10. Portfolio Balance across Disciplines and Sub-disciplines

The COV recognizes the significant challenge (across disciplines and subdiscipline funding in determining an appropriate balance with such a diverse portfolio and limited funding. Some members of the COV had the impression that research related to microbes and fungi were underrepresented in funded research relative to other taxa. In addition, the COV noted that there was lack of balance in funding rates among the clusters. Some members of the COV noted that funding rates in neuroscience were lower than in other clusters. The highly fluid organizational structure of the clusters facilitates effective assignment of proposals for review. The COV was impressed in discussions with the Program Officers that they de-emphasize disciplinary and subdisciplinary boundaries.

IOS Comments: The re-alignment of IOB into IOS has made it possible to overcome the prior disciplinary boundaries that impeded flexibility within the division. Panels are now able to be “routinely re-constituted” in meaningful ways to accommodate the increasing scientific diversity in IOS proposal submissions. Program Directors are encouraged to attend panels other than those that they are managing so that they are scientifically informed and can make cluster level decisions regarding funding. All of the IOS staff is encouraged to attend each post-panel debriefing as another means of increasing communication and awareness of the entire IOS portfolio. In efforts to expand funding opportunities for research in other taxa, including microbes and fungi, the IOS staffing plan for FY 2009/2010 includes recruitment of a rotator Program Director with expertise in microbial biology. Efforts have also been made within the last year to increase to the Neural Systems Cluster budget so that funding rates more closely align with those of the other clusters.

11. Portfolio Appropriate Participation of Underrepresented Groups

The COV noted the increasing number of proposals and increasing funding rates for research grants to underrepresented minorities, although overall numbers are still distressingly low. IOS should continue to support underrepresented minorities throughout their education to increase the pipeline of minorities in science. QEM workshops that are funded by the Biology Directorate may be having a positive impact on the number and quality of proposals submitted.

IOS Comments: IOS will continue to focus on a variety of outreach activities that encourage investigators from under-represented groups and from minority-serving institutions to submit proposals and to participate in every facet of the merit review process. Broadening participation is an integral component in the performance plan for all of the Program Directors, the Acting Deputy Division Director, and the Acting Division Director. Outreach and broadening participation will be one of the topics emphasized at the Division retreat in September, 2008.

12. Relevancy to National Priorities, Agency Mission, Relevant Fields and Other Constituent Needs

The COV noted that the self-study report highlights awarded projects that are directly relevant to priorities and missions. The COV also notes that IOS's overall portfolio continues to make strong and sustained efforts in research and education in sciences. These activities are in accord with principles articulated in the National Research Council Report "The role of theory in advancing 21st century biology - catalyzing transformative research." The COV notes that IOS is taking the lead within the directorate in the use of eJackets for processing of all proposals. The COV applauds this effort in "going paperless."

IOS Comments: The Division appreciates the Committee's recognition of our efforts and activities in these critical areas.

13. Additional Comments on Portfolio Balance

The COV was highly impressed by the quality and breadth of the integrative projects that were awarded. The COV was also impressed by the quality of many of the declined proposals and wished that there were sufficient funding to support them as well.

IOS Comments: IOS is grateful for this recognition and agrees that many meritorious proposals are being declined due to budgetary constraints.

A.4 Management of the Program under Review

1. Management of the Program

The COV notes that the management of IOS is outstanding. It is clear that the division works as a team at all levels. The acting division director and deputy were able to articulate clearly the goals as well as functioning and practices of the division. They set a supportive, collegial tone for the division. The Program Officers are outstanding in terms of their knowledge of their fields and ability to manage large proposal loads. They work effectively as a team, both within and across clusters. Because of the importance of institutional memory, continuity, and experience, the COV supports the goal of increasing the proportion of permanent Program Officers. These hires present an opportunity to increase the racial and ethnic diversity of the Program Officers. The administrative staff operates effectively, working closely together as a cohesive and mutually supportive team. Professional development is clearly a priority in IOS, and this emphasis is reflected in the professionalism, enthusiasm, and stability of the administrative staff. Because of cross-training, staff members are able to manage an intense and dynamic workload. The Science Assistants and STEP students make important contributions to the division. Their experiences at IOS will surely contribute to their future professional development. The understanding of the division's mission by personnel at all levels was particularly impressive to the COV and is an asset to the research community it serves.

This division is a model for others within the Foundation.

IOS Comments: The Division is very appreciative of the Committee's recognition of all of our efforts to serve the community.

2. Responsiveness of the Program to Emerging Research and Education Opportunities

IOS not only responds to research trends, but also provides leadership to the research community. Emerging areas are identified through exchange of ideas and proposals across clusters, divisions, and directorates. The inclusive nature of the program descriptions available online encourages the submission of a broad range of exciting proposals. The recent realignment has increased the responsiveness of IOS programs to Pls. Through its emphasis on the importance and diverse nature of broader impact activities, IOS achieves effective integration of education with research.

IOS Comments: The COV's recognition of IOS efforts in this area is appreciated.

3. Program Planning and Prioritization Process (internal and external) that Guided the Development of the Portfolio

A productive and exciting focus on systems biology is a strong theme in IOS. This is reflected in the realignment and in guidance derived from the recent National Research Council report "The role of theory in advancing 21st century biology - catalyzing transformative research." Published reports from IOS workshops show that IOS is soliciting and investing in new research visions from a broad array of scientists.

4. Responsiveness of Program to Previous COV Comments and Recommendations

Overall, IOS responses to the previous COV's recommendations are excellent. Indeed, the changes that have been instituted since and in response to the recommendations of the 2005 COV have significantly strengthened the division internally and with respect to the position of IOS in the BIO Directorate.

Nonetheless, there remain recommendations that have not been adequately addressed. Among these are a set of recommendations related to tracking award outcomes and adequately addressing review criterion #2, Broader Impacts.

Continuing issues related to tracking award outcomes yield the following recommendations:

- *Better tools must be developed for tracking the Division's ability to support outstanding science and education.*
- *If NSF were more proactive in assessing the outcomes of its awards, the Foundation should be able to more clearly document its successes.*
- *Improved collection of outcome data will greatly assist the foundation in justifying budget requests to congress*
- *Improved tracking of outcomes from funded research by collecting data electronically in annual and final reports.*

IOS Comments: The Division recognizes the importance of these recommendations and will continue to work actively with the NSF-wide working group that is developing revised and improved annual and final project reports and assessment mechanisms.

Despite the efforts of IOS, there has been no change in the annual and final project templates and the ability to assess outcomes of awards remains inadequate. While the COV acknowledges that there is considerable inertia to change Foundation-wide documents, these templates represent a significant impediment to assessment of the fundamental goals of the division and the entire NSF. The 2008 COV echoes the 2005 COV's recommendations and supplements them with division-level recommendations to address this issue in advance of changes at the Foundation level.

Continuing issues related to tracking Broader Impact outcomes included the following

- *The NSF continue to stress the importance of review criterion 2 to both investigators and reviewers and develop measures to assess the impact of this criterion on NSF's outcome goals for discovery, learning, and research infrastructure.*
- *Program Directors continue to stress to reviewers (both ad hocs and panelists) the importance of addressing criterion 2 with a level of rigor and insight consistent with assessments brought to other components of the proposal. Furthermore, the Program Directors should be vigilant in enforcing the return without review policy for proposals not addressing criterion 2.*

Substantial effort has been made on the part of the division to improve the visibility of this criterion at panels and in the funding process. However, as the IOS also recognizes there is still inadequate consensus on metrics to assess the value of Broader Impacts.

IOS Comments: See comments addressed in section A.1 question 2.

5. Additional Comments on Program Management

Co-review of proposals is a common practice within the division, ensuring that proposals receive the best possible reviews.

PART B. RESULTS OF NSF INVESTMENTS

1. OUTCOME GOAL for Discovery

The IOS has clearly supported research consistent with this Goal.

COV identified examples:

CAREER (0546858) Venom evolution in sicariid spiders: A system for undergraduate training in integrative biology." It exemplifies IOS's efforts to support new investigators. It has outstanding scientific range and depth, and a highly developed undergraduate and community outreach program.

(0642249) The energetic cost of burrowing. This multidisciplinary project from a female National Academy member has transformative potential. It will change the understanding of the role of worms in biogeochemistry by their effect on soil mixing. This project has strong outreach components, including teaching scientists how to interact with the media.

(0714156) The ecophysiology of early angiosperms. This new investigator proposes to study the evolutionary constraints on flowering plants. The proposal will be influential in understanding life in transition, in particular, how plants cope with climate change. This proposal has a unique international component in which US undergraduates will partner with Peruvian and Papua New Guinean undergraduates in field research projects.

The COV found a number of other noteworthy awards addressing critical national needs, including those in animal/bacterial symbiosis (0517007), pathogen/defense regulation (0715926), homeostatic regulation of neuronal ion channels (0641370), and a research coordination project focused on plant/virus ecology (0639139).

2. OUTCOME GOAL for Learning

The vast majority of IOS awards support the development of the scientific workforce. Many also expand scientific literacy through K-12 outreach and development of activities that involve the public in science-based activities.

The 2005 COV report contained a comparable section titled Outcome Goals for People. This statement is strikingly consistent with the 2008 COV's views, both in terms of strengths and weaknesses. Both groups noted that the division is working exceptionally hard to promote a broad range of highly creative educational activities, including activities that bring scientists together with K-12 teachers. For example, an MBL workshop enabled 24 high school teachers to discover "the microbial world within," which led to the development of new teaching modules for high school students. As another example, a Harbor Branch Oceanographic Institute cruise involved high school teachers, undergraduates, graduate students and postdocs in research to understand the vision in shrimp. Their experiences were chronicled and that log was made available online for the purpose of public education.

Much of the relevant data on Broader Impacts is well-documented in annual and final reports, but in this form it is not easily accessed by Program Officers and review panels. It was therefore extremely difficult for the 2008 COV to determine the learning outcomes resulting from IOS awards. The COV **STRONGLY** recommends modifying the annual and final reports to facilitate data collection to address this outcome goal.

3. OUTCOME GOAL for Research Infrastructure

IOS has supported research that has led to the development of new research tools and the use of existing tools in innovative ways.

For example, IOS researchers used a novel technique called Scientific Rotoscoping to visualize the movement of bones within a living organism. This technology involves simultaneously recording standard video of moving animals, and X-ray images of their moving skeletons. From these images an animated 3-D computer model of the moving skeleton overlaid on the digital recording of the moving animal can be used to study coordinated skeletal movement with animal movement for the first time. Based on the findings of this research, the investigators are building a dual x-ray facility, simplifying and enhancing the Scientific Rotoscoping.

As a second example, another IOS scientist is part of a project that is establishing a national facility for studying the neuroanatomical and functional organization of the mammalian brain. This is being accomplished by assembling the contents of three major comparative mammalian brain collections. This is the first comparative neuroanatomical database of its kind and will be made readily available to teachers at all levels of education and to the public at large.

PART C. OTHER TOPICS

1. Program areas in need of improvement or gaps (if any) within program areas

As a result of its realignment and strong portfolio of integrative biology, IOS is ideally suited to participate in large-scale projects such as Life in Transition and NEON. There are also new opportunities to leverage existing NSF resources. For example, organismal and systems biologists could participate in research at established LTER sites. Collaborations of IOS with such programs should be a priority.

IOS Comments: The Division recognizes the importance of this suggestion and will increase its efforts to reach out to other units within the Foundation and to also increase efforts to inform the scientific community about funding opportunities beyond IOS. This suggestions will be discussed extensively at the September 2008 IOS Division Retreat.

2. Program's performance in meeting program-specific goals and objectives that are not covered by the above questions

The COV has no additional comments.

3. Agency-wide issues that should be addressed by NSF to help improve the program's performance

The COV has identified the difficulty of collecting outcome data from annual and final reports as a major barrier to assessing research and broader impact outcomes. Development of a new report template that facilitates collection of data for assessment is essential. PIs should be strongly encouraged to provide demographic data on all personnel involved in NSF-funded projects. A strong focus on inclusion of underrepresented minorities at all levels (PIs, reviewers, panelists, staff) must be maintained. Clearer guidance should be provided to PIs and reviewers on the development and assessment of Broader Impact grant components.

IOS Comments: See comments addressed in sections:

Section A.1. Question 2

Section A.2. Question 2

Section A.3, Question 1

Section A.3. Question 9

4. Comments on any other issues the COV feels are relevant

The COV has no additional comments.

5. Comments on how to improve the COV review process, format and report template

Documents summarizing the overall organizational structure of NSF would have been helpful to have prior to the COV to give COV members a clear, up-to-date idea of the position of IOS within NSF. A guide to NSF acronyms would have been helpful.

IOS Comments: IOS will provide an NSF organization chart and an acronym guide for the next COV.

The COV was hampered in its activities because of the lack of key descriptive statistics and the difficulty of extracting information from NSF databases regarding individual proposals (for example, the demography of IOS-supported graduate students and the number of proposals submitted to a panel in a particular cycle). New database structures and/or new data mining tools should be developed for the compilation and analysis of the information that NSF collects.

There appears to be a subtle mismatch between the assessment requested (which appeared to require analysis of descriptive statistics) and the evidence provided (examples, highlights, and specific proposals). The COV is not an advocate of “bean counting” without context, as its answers to many of the preceding questions might imply. But anecdotes are more powerful when supported by the numbers. Thus, the COV sees a need for a revised COV report template that permits easier merging of quantitative and qualitative judgments.

IOS Comments: This recommendation will be communicated to the NSF-wide working group responsible for development of the COV report template.

ADDITIONAL IOS-Specific Questions:

- 1. Funding rates across the Foundation have declined during the period under review, due in large part to budgetary limitations. There is also an increasing emphasis on identification and funding of potentially transformative research. Given these funding constraints, are IOS Program Directors taking appropriate risks to enable transformative research? What metrics can be applied to monitor the effectiveness and impact of IOS emphasis on supporting transformative research?**

Now that NSF asks PIs to consider and state whether their proposed research is potentially transformative, the COV suggests that PIs, reviewers, and panelists be alerted to the newly adopted language in the Grant Proposal Guide, perhaps even on the IOS homepage. In addition, COV hopes that program officers will be able to assist PIs in identifying potentially transformative aspects of proposed research. In discussions with the program officers, the COV learned that transformative research can be defined and assessed differently from panel to panel in IOS, and that such flexibility and fluidity were regarded as positive. The program officers and the COV also recognize that not all meritorious work will be transformative.

IOS Comments: The GPG now contains information regarding transformative research. In addition, the Acting Deputy Division Director and the Acting Division Director met with each Advisory Panel last spring to ensure that panelists were aware of this new addition to the Intellectual Merit review criterion.

The question of what percent of funding from each cluster should be allocated to transformative research was not fully resolved. A rough estimate of the current allocation might be 5-10%, and program officers stated that not all potentially transformative proposals were funded. The COV believes that program officers are exercising appropriate judgment in determining the level of resources to be applied to potentially “risky” yet possibly transformative science. Occasionally, but not always, SGER grants can be used to support potentially transformative research.

IOS Comments: IOS appreciates the Committee’s recognition that Program Directors are “exercising appropriate judgment”. Division-wide and Cluster-level discussions about what constitutes “appropriate risk” are ongoing to ensure that this practice continues in IOS.

The COV concurred with the program officers that the nature and funding of transformative research needs to remain flexible. Nevertheless, the COV recommends that IOS develop tracking tools to measure and monitor the transformative success of each proposal; such metrics might include adoption of research methods and concepts by other disciplines, high impact publications, patents and invention reports, etc.

IOS Comments: The NSF-wide FacTIR (Facilitating Transformative and Interdisciplinary Research) Working Group is developing recommendations with respect to identifying and tracking proposals and awards that are potentially transformative.

- 2. The recent realignment of the Division has led to an increased emphasis on systems analyses. We would appreciate feedback from the COV on IOS-related topics that could be targeted for one time, short term investment that would enhance our existing portfolio. In this same context, we would appreciate advice from the COV about how IOS may stimulate discussions about systems approaches to understanding organisms in the PI communities served by IOS.**

Scientists funded by IOS work on phenotypes and functionality, thus forming a bridge from molecular biology at smaller scales to population biology and ecology at larger scales. As such, IOS comprises people, approaches, and tools that can connect work going on in other divisions. Perhaps IOS could make special efforts to promote work that forms new links between traditional IOS approaches and research in other divisions. Further, the position of IOS as a natural link could enhance broader impacts by forming stronger partnerships with EHR to increase the utilization of organismal biology in training and outreach portions of projects.

IOS Comments: The Division appreciates this recommendation and will include this as a topic for discussion at the September 2008 IOS retreat.

We feel that the COV is not necessarily the best body to recommend topics for special support. Because of their broad exposure to cross-cutting science, the COV recognizes that program officers within the division are better able to identify special program opportunities and to set division priorities.

Nonetheless, we have some ideas:

- 1) “Mini-training” grants - much smaller scale (cohorts of 3-4 students) but targeting interdisciplinary work between labs working in divergent areas
- 2) Methodological development - provide additional support for research that adopts new technologies (i.e., technologies that are currently under-utilized in IOS-supported research). This suggestion arises from our perception that integrative biology requires research breadth, often at the expense of specialization that fosters technological expertise. Additional funding could be used, for example, to allow IOS PIs to add collaborators who are technological specialists or to train outside their specialty.
- 3) The BioAC representative on our COV informs us that “Life in transition: origins, adaptation, energy” is to be a new priority area for the Biology Directorate. Research in IOS is already well aligned with this theme; thus, there may be opportunities to couple IOS special funds with other sources of funding within the directorate.
- 4) The COV is impressed that functional genomics, behavior, and development are now prominent in ecological and evolutionary research, including long term projects that have sought the mechanistic bases of adaptive evolutionary change. Two examples are the discovery of genes regulating beak size differences in Galapagos finches (funded by IOS: 061627) and work showing the genetic and physiological bases of recurrent ecologically-driven divergence of stickleback fish. The COV feels that IOS should encourage projects that link behavioral and functional studies with LTER and NEON projects, and that such linkage will provide a rich scientific yield.
- 5) The COV also strongly encourages the support of cross-cluster projects within IOS.
- 6) Based on panel experience, the COV recognizes that there are often highly meritorious proposals that are so expensive that they would dominate the budget of individual panels. Funds could be strategically applied to support especially exciting (including potentially transformative) proposals that exceed budgetary limits of panels.

IOS Comments: The Division appreciates each of these ideas and will discuss them further at the September IOS Retreat and at subsequent staff meetings, as future new funding opportunities are being developed in the Division and the Directorate.

3. **Please provide advice regarding strategies that IOS might employ to encourage PIs to include assessment and impact metrics with respect to descriptions of Broader Impacts in their proposals?**

By examining external and panel reviews of approximately 80 proposals, the COV determined that reviewers now pay more attention to broader impact criteria; increased attention and creativity related to this criterion were noted over the three year period. It was clear that virtually all panel summaries paid considerable attention to broader impacts of the proposal.

Nevertheless, the COV believes that IOS needs to continue to ensure that PIs, as well as reviewers, understand the importance of this criterion for every proposal. Excellent experimental design without significant broader impacts is not excellent, fundable science. The COV also noted that it is not clear to PIs how broader impacts are assessed and how this information is used by the Foundation. The COV believes that there is first-rate information about the outcomes of broader impacts in annual and final reports. These data are not adequately mined and evaluated by IOS.

In the short term, the COV recommends that a scientific assistant be assigned to compare the outcomes of broader impacts described in annual reports with broader impacts described in proposals, and to provide feedback to PIs. In the long term, the COV recommends changes to the annual and final report forms to provide simple rubrics about broader impacts that can be mined more easily to produce concrete, quantifiable data. For example, race/ethnicity of students trained could be entered in a form easy to track. IOS should also keep track of institutions that are particularly strong in broader impacts and consider recognizing the achievements at these institutions.

IOS Comments: IOS staff will continue to work toward developing efficient and effective means to monitor and track these activities. In addition, the Directorate is developing enhanced resources for the community with respect to broader impacts that includes the posting of specific examples on the BIO homepage.

4. How can we improve the descriptions of our Clusters to make their emphases clearer to potential PIs?

Based on discussions with IOS POs, the COV understands that the goal of the Division and Cluster descriptions is to inform the PIs about funding priorities and program organization. In line with these goals, the COV felt that the current IOS Division and Cluster descriptions are very much improved and inclusion of relevant links and funding rates are particularly helpful. The COV had suggestions for additional improvement.

- 1) The COV recommends that the Cluster and Program descriptions adequately highlight the ways in which work in IOS integrates into NSF BIO's emphasis on Life in Transition: origins, energy and adaptation. This connection should feature prominently on the "About IOS" page and a link should be made to the Bio AC's recent presentation on Life in Transition
- 2) The "About IOS" summary description should include a statement about proposals appropriate for review in more than one cluster to explain that POs work together to assure the best review and co-review.
- 3) In comparison to the other Cluster descriptions, the COV felt that the description of the Behavioral Systems Cluster is not sufficiently substantive. Additional detail should highlight the breath/scale and depth of work funded in the Cluster.
- 4) Descriptions of the programs within the Developmental Cluster need to be edited to remove redundancies. The COV felt that the questions provided in the Evolution of Developmental Systems Program description or the information provided by the Neural Systems Cluster were very helpful and could serve as models.
- 5) The COV suggests that all descriptions be edited and proofed very carefully.

- 6) The descriptions of Program Officers' areas of expertise should be more informative and uniform in detail across clusters; the links at the top of the page should link to that same descriptor

IOS Comments: IOS appreciates the COV's recommendations for improving communications by significantly revising the IOS website. IOS is in the process of re-vamping its website and discussions about how best to accomplish these goals will be a key topic for the Division's September 2008 retreat.

5. Are there important areas of investigation/ research communities in organismal biology that are not well-served or overlooked, by the current Cluster/ Panel structure? If so, how might this be best addressed?

Based on the descriptions of the clusters, as well as the range of projects that have been supported over the past three years, the COV felt that most of the important facets of organismal biology are currently being served quite well. The realignment of the cluster structure is more effectively covering all areas than did the previous IOB structure. The COV noted that, as the emphasis on theory increases, as seems likely given the current focus of IOS, it will be important to ensure that sufficient reviewer expertise in that area is included. The COV did discuss several topical areas that do not fit easily within the described clusters. However, given the fluidity with which the program officers are now formulating panels, it is likely that these areas can be accommodated within the current structure, particularly if the PIs speak with program officers before proposal submission. There were, however, several specific topical areas for which the COV did not see an obvious fit in the cluster descriptions. The COV thus recommends that IOS clarify that the following are included within IOS, and identify the cluster to which proposals addressing these questions should be submitted.

- The role of microbes in all appropriate areas. The COV noted that microbes were explicitly mentioned in only one cluster description, but should be included in many of these descriptions.
- Descriptive or discovery-based studies of neural systems at the genomic level.
- Studies of animal behavior that include a psychological focus.
- Mathematical modeling of developmental processes and phenomena.

IOS Comments: IOS will address each of these recommendations as the cluster descriptions are revised.

The COV noted that IOS has been very responsive to new developments that arise within the realm of integrative and organismal biology. For example, evolutionary studies of development are relatively new, but IOS has responded to the demand and the possibilities of advances in knowledge and understanding inherent in this melding of disciplines. This was evidenced most recently by the impressive response to the 2005 workshop on Evo Devo by the elevation of this topic to a designated subtopic within the Physiological and Structural Systems Cluster. Maintaining this same level of responsiveness and vigilance will be important as new areas arise in the future.

COV RECOMMENDATIONS

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS

- **Provide clear data for the COV to assess the effectiveness of the merit process.**
The staff had difficulty in extracting critical data such as demographics and number of proposals that were co-reviewed from the existing databases in order to allow the COV to evaluate certain aspects of the programs.

IOS Comments: IOS will include a data section that will address this topic in the self-study prepared prior to the next COV.

- **The COV recommends that IOS develop a strategy that will allow easy tracking of proposals that are designated as potentially “transformative”.** Program Officers and panel members should also create a record for the rationale for this designation. This will support the NSF-wide goal of support transformative research and will assist in the documentation thereof.

IOS Comments: The NSF-wide FacTIR (Facilitating Transformative and Interdisciplinary Research) Working Group is developing recommendations with respect to identifying and tracking proposals and awards that are potentially transformative.

- **The COV recommends investment in the development of tracking and assessment tools to measure and monitor the success of each proposal.** The annual/final reports should be used to gather information on the impact of the award (students trained, publications, grant awards, student and post doc training, presentations, invention reports, adoption of research methods and concepts by other disciplines, etc.).

IOS Comments: See comments addressed in section A. 3 question 1

- **The COV recommends that the NSF provide clearer language, guidance, and examples of expected broader impact aims for all levels of the application and review process.**

IOS Comments: See comments addressed in section A. 1 question 2

- **The COV recommends that the PI include in the grant application supporting documentation for not only the research but also the broader impact component of the project.**

IOS Comments: The Division will forward this recommendation to the NSF Policy Office for their consideration.

- **The COV recommends that IOS Program Officers continue to emphasize to panelists the need to comment more substantively on the merit of proposed Broader Impact activities and communicate that to PIs in the panel summary.**

IOS Comments: See comments addressed in section A. 1 question 6.

- The COV recommends changes to the annual and final report templates to provide simple rubrics about broader impacts that can be mined more easily to produce concrete, quantifiable data.
IOS Comments: See comments addressed in section A. 3 question 1.
- The COV recommends IOS should identify institutions that are particularly strong in broader impacts and recognize their achievement.
IOS Comments: The Division appreciates this suggestion and will include it in discussion at the September 2008 IOS Retreat.

SELECTION OF REVIEWERS

- The COV recommends that the NSF revise instructions to applicants and reviewers to emphasize the importance of providing accurate and complete demographic data to the overall mission and accountability of the NSF.
IOS Comments: Because of potential legal implications, the Division is unable to act directly on this recommendation, but will forward it to the NSF Office of General Counsel.
- The COV recommends that the IOS continue to invite a diverse array of panelists from different ethnic groups, areas of the US, and types of institution to ensure breadth in the review process.
IOS Comments: The Division is completely committed to the importance of this recommendation.
- As the emphasis on theory increases, it will be important to ensure that sufficient expertise in that area is included in the review process.
IOS Comments: IOS Program Directors will continue to request reviews from a diverse set of reviewers to ensure that all aspects of each proposal receive a qualified and fair review.

RESULTING PORTFOLIO OF AWARDS

- IOS must continue to advocate for more funds as the number of meritorious proposals far exceeds what the division can fund.
IOS Comments: The Division appreciates this recommendation and will continue our efforts to increase funding for the Division.
- The Program Officers' review analysis template should include a query that designates a project as inter- and/or multi-disciplinary.
IOS Comments: See comments addressed in section A. 3 question 5.

- The IOS should consider using one-time target funds (\$5-10M) to underwrite inter-/ multi- disciplinary research that involves multiple PIs.

IOS Comments: The Division will discuss this recommendation at the September 2008 IOS Retreat and consider taking funds “off the top” in the Division to provide incentive funding for inter/multi-disciplinary research.

- The IOS should continue to promote the support of new investigators and proposals from EPSCoR states and tribal colleges and universities.

IOS Comments: The Division agrees with the COV that it is critical to invest in proposals from investigators in EPSCoR states and at tribal colleges and universities.

- Given the lack of awards to Tribal colleges and universities, the COV encourages IOS to promote outreach efforts to identify and mentor PIs from these institutions.

IOS Comments: See comments addressed in section A.3 question 9.

- The IOS should Increase the quality and number of underrepresented minority PIs that receive funding through mechanisms such as Quality Education for Minorities workshops.

IOS Comments: IOS will continue to focus on a variety of outreach activities that encourage investigators from under-represented groups and from minority-serving institutions to submit proposals and to participate in every facet of the merit review process. Broadening participation is an integral component in the performance plan for all of the Program Directors, the Acting Deputy Division Director, and the Acting Division Director. Outreach and broadening participation will be one of the topics emphasized at the Division retreat in September, 2008.

MANAGEMENT

- The IOS should develop metrics that highlight notable successes for self assessment (including future COVs). For example, how many CAREER awardees are selected for PECASE awards? How many IOS awardees are members of the National Academy of Sciences (or have been otherwise recognized nationally and internationally)?

IOS Comments: The Division will forward these recommendations to the NSF-wide working group responsible for development of the COV report template.

- The IOS should continue to increase the proportion of permanent Program Officers, as well as the diversity of the Program Officers.
IOS Comments: IOS is currently interviewing candidates for a permanent Program Director position in the Behavioral Systems Cluster. The FY 2009/FY 2010 IOS staffing plan includes recruitment activities for additional permanent Program Directors in the Physiological and Structural Systems Cluster and in the Neural Systems Cluster.
- The COV recommends that Science Assistants be assigned to compare the outcomes of broader impacts described in annual reports with proposed broader impact described in proposals, and provide feedback to the division.
IOS Comments: The Division appreciates this recommendation and will assign this task to IOS staff members in FY 2009.

IMPROVING INFORMATION DISSEMINATION

- The IOS should strive for more uniformity in cluster descriptions with respect to content, style and level of detail.
IOS Comments: See comments addressed in IOS Specific Question 4
- The IOS should provide additional links to existing NSF resources from their homepage. For example, new investigators could be directed to examples of excellent proposals.
IOS Comments: The Division will continue to work on improving the utility of the IOS homepage for all investigators.

OTHER TOPICS

- The IOS should create new opportunities to leverage existing NSF resources such as participation in research activities at LTER sites and NEON.
IOS Comments: The Division will increase its efforts to inform the scientific community of activities like LTER and NEON.
- The IOS should develop a new report template that facilitates the collection of data for assessments, especially of broader impacts.
IOS Comments: The Division will continue to work with the NSF-wide working group responsible for revision of the annual and final project report templates.
- The IOS should develop new (relational) data base structures and/or new data mining tools for better compilation and analysis of the information that NSF collects.
IOS Comments: The Division does not have either the financial or the human resources to address this recommendation. However, IOS will

forward this recommendation to NSF's Division of Information Services and encourage them to increase their efforts in this area.

ADDITIONAL IOS-SPECIFIC ISSUES

Q1 Transformative research:

- **PIs, reviewers, and panelists should be alerted to the newly adopted language in the Grant Proposal Guide, perhaps even on the IOS homepage.**

IOS Comments: See comments addressed in IOS Specific Question 4.

- **Program Officers and panelists should clearly identify the transformative potential of proposals.**

IOS Comments: See comments addressed in A.3 question 4.

Q2 Things to do with one-time investment:

- **The COV was pleased with the current role of Program Officers in developing these areas and provided some ideas for IOS consideration.**

Q3 Assessment and impact metrics

- **IOS needs to continue to ensure that PIs, as well as reviewers, understand the importance of the broader impacts criteria for every proposal. Excellent experimental design without significant broader impacts is not competitive, fundable science.**

IOS Comments: See comments addressed in A.1 question 2.

Q4 Descriptions of Clusters

- **The COV recommends that the Cluster and Program descriptions adequately highlight the ways in which research funded by IOS interfaces with the NSF BIO's emphasis on "Life in Transition: origins, energy and adaptation".**

IOS Comments: The Division appreciates this recommendation and will include references to the Life in Transition themes in revised cluster descriptions.

- **Educate the community about the nature of the co-review process.**

IOS Comments: IOS staff will increase their efforts to discuss the co-review process at all outreach activities.

- **The online cluster descriptions should be equivalent in their depth and breath.**

IOS Comments: See comments addressed in IOS Specific Question 4.

- The descriptions of Program Officers' areas of expertise should be more informative and uniform in detail across clusters.

IOS Comments: See comments addressed in IOS Specific Question 4.

Q5 Areas not well-served

The COV suggests several areas that may not be well served by the current structure and recommends that the IOS evaluate these suggestions and adjust their priorities appropriately.

- The role of microbes in all appropriate areas. The COV noted that microbes were explicitly mentioned in only one cluster description, but should be included in many of these descriptions.
- Descriptive or discovery-based studies of neural systems at the genomic level.
- Studies of animal behavior that include a psychological focus.
- Mathematical modeling of developmental processes and phenomena.

IOS Comments: IOS will address each of these recommendations as the cluster descriptions are revised.